# Centrifugal Pump
## Operation, Maintenance, & Technical Manual

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1.0 Safety

General safety rules and warnings

This manual contains important information concerning installation, operation, and proper maintenance of MAKDADDY® Centrifugal Pump. To prevent injury to personnel or equipment damage, this manual should be read by those responsible for the installation and operation of the equipment. In addition, the safety precautions below should be followed at all times.

TURN OFF. LOCK OUT and TAG OUT the electrical power supply to the unit before working on the electrical system or electrical motors or starters.

1. Lift the Pump only at lift points detailed in this manual and use properly rated slings capable of handling the equipment weight. Look for a buildup of dried solids or stored equipment in or on the equipment that may cause the lift load to exceed those listed in this manual.

2. The structure on which the unit is to be installed must be capable of supporting the operational (or wet) weight listed in this manual.

3. The unit should only be installed in an area where walkways, lighting, and handrails allow safe access for periodic maintenance.

4. Never make weld repairs to the Pump while the unit is running.

5. Never lay tools or equipment on the Pump.

6. Falling objects discharged from the Pump can cause injury to persons working on or near the unit.

7. Inspect the unit regularly, and replace any damaged or worn component. Use only parts supplied by the original equipment manufacturer.
2.0 Warranty

Warranty Terms and Conditions
The MAX2000®, MAKDADDY®, and Vak® name are registered trade names of Kelbro, Inc dba Process Solutions International (PSI). Their use is reserved by Kelbro, Inc. dba Process Solutions International (PSI) and applicable laws. It shall not be used without permission and written authorization from Kelbro, Inc. dba Process Solutions International (PSI).

Terms of Sale
Any terms and conditions contained in any purchase order or other form of communication from PSI’s customers, which are additional to or different from these terms and conditions, shall be deemed rejected by PSI unless expressly accepted in writing by PSI. In general, no modification, amendment, waiver or other change of any of these terms and conditions or attachments hereto, or of any of PSI’s right or remedies thereunder, shall be binding on PSI unless expressly accepted in writing by PSI’s authorized officers. No course of dealing, usage of trade or course of performance shall be relevant to explain or supplement any of these terms and conditions. If any document issued by any party hereto is sent by facsimile or another form of electronic document transmission, the parties hereto agree that (a) the copy of any such document printed on the facsimile machine or printer of the recipient thereof is a counterpart original copy thereof and is an “writing”, (b) an electronically stored and reproduced copy of any such document shall be deemed to be legally sufficient evidence of the terms of such document for all purposes.

Delivery; Risk of Loss
All sales are F.O.B. PSI’s plant or other point of shipment designated by PSI. Shipping dates are estimates only which are not guaranteed and are based upon prompt receipt from Buyer of all necessary shipping and other information. PSI reserves the right to make delivery in installments, all installments to be separately invoice and paid for by Buyer when due per invoice, without regard to subsequent deliveries. Delivery of equipment to a commercial carrier at PSI’s plant or other loading pint shall constitute delivery to Buyer, and any risk of loss and further cost and responsibility thereafter for claims, delivery, loss or damage, including, if applicable, placement and storage, shall be borne by Buyer.

When equipment is delivered by PSI’s truck, unloading at Buyer’s dock shall constitute delivery to Buyer. Claims for shortages or other errors in delivery must be made in writing to PSI within ten (10) days after receipt of shipment and failure to give such notice shall constitute unqualified acceptance and a waiver of all such claims by Buyer. Claims for loss or damage to equipment in transit by common carrier must be made to the carrier and not to PSI. Freight and handling charges by PSI may not reflect actual freight charges prepaid to the carrier by PSI due to incentive discounts earned by PSI based upon PSI’s aggregate volume of freight tendered to a carrier or when a carrier must be used which charges a rate which is different than the rate upon which PSI’s freight and handling charges were based. When shipments are delivered in PSI’s private trucks, Buyer will be charged an amount approximating the prevailing common carrier rate.
**Excusable Delays; Force Majeure**

PSI shall not be liable for any ordinary, incidental, or consequential loss or damage as a result of PSI’s delay in or failure of delivery or installation due to (i) any cause beyond PSI’s reasonable control, (ii) an act of God, act of the Buyer, embargo or other government act, authority, regulation or request, fire, theft, accident, strike, slowdown, or other labor disturbance, war, riot, delay in transportation, or (iii) inability to obtain necessary labor, material, components, or facilities.

Should any of the aforementioned events of force majeure occur, PSI, at its option, may cancel Buyer’s order with respect to any undelivered equipment or extend the delivery date for a period equal to the time lost because of delay. Notice of such election shall be given promptly to Buyer. In the event PSI elects to so cancel the order, PSI shall be released of and from all liability for failure to deliver the equipment, including, but not limited to, any and all claims on behalf of Buyer for lost profits, or any other claim of any nature which Buyer might have.

If shipping or progress of the work is delayed or interrupted by Buyer, directly or indirectly, Buyer shall pay PSI for all additional charges resulting therefrom.

**Storage**

If the equipment is not shipped within fourteen (14) days after notification has been made to Buyer that it is ready for shipping, for any reason beyond PSI’s control, including Buyer’s failure to give shipping instructions, PSI may store the equipment at Buyer’s risk and expense in a warehouse or on PSI’s premises, and Buyer shall pay all handling, transportation and storage costs at the prevailing commercial rates promptly following PSI’s submission of invoices for such costs.

**Warranty Period**

PSI warrants the products manufactured under the Kelbro register trade name mentioned above to be free from defects in materials and workmanship and to conform to PSI written specifications for a period of 12 months from the date of manufacture.

**Warranty Remedies**

If, prior to expiration of the foregoing applicable warranty period, any of such products shall be proved to PSI’s satisfaction to be defective or nonconforming, PSI will repair or replace such defective equipment or components thereof, F.O.B. PSI’s plant or other destination designated by PSI, or will refund or provide Buyer with a credit in the amount of the purchase price paid therefore by Buyer, at PSI’s sole option. Buyer’s exclusive remedy and PSI’s sole obligation under this warranty shall be limited to such repair or replacement, F.O.B. PSI’s plant or other destination designated by PSI, or refund or credit by PSI, and shall be conditioned upon PSI’s receiving written notice of any defect within a reasonable period of time (but in no event more than thirty (30) days) after it was discovered or by reasonable care should have been discovered. In no event shall PSI’s liability for such defective or nonconforming products exceed the purchase price paid by Buyer therefore.

**Exclusions**
This warranty does not (i) cover shipping expenses to and from PSI factory or other destination designated by PSI for repair or replacement of defective equipment or any tax, duty, custom, inspection or testing fee, or any other charge of any nature related thereto, nor does it cover the cost of disassembling or removing defective equipment or reassembling, reinstalling, or testing repaired or replaced equipment or finishing the reinstallation thereof, (ii) apply and shall be void with respect to equipment operated in excess of rated capacity or otherwise not in accordance with installation, maintenance, or operating instructions or requirements, to equipment repaired or altered by others than PSI or PSI’s authorized service agencies, or to equipment which was subjected to abuse, negligence, misuse, misapplication accident, damages by circumstances beyond PSI’s control, to improper installation (if by others than PSI), operation, maintenance or storage, or to other than normal use or service, and (iii) apply to equipment or components not manufactured by or for PSI. With respect to equipment or components not manufactured by PSI, PSI’s warranty obligations shall in all respects conform and be limited to the warranty actually extended to PSI by its suppliers, but in no event shall PSI’s obligation be greater than those provided under PSI’s warranty set forth in this section.

The foregoing warranties are in lieu of all other express and implied warranties (except title), including, without limitation, the implied warranties of merchantability and fitness for a particular purpose. No employee, representative, or agent of PSI other than an officer of PSI is authorized to alter or modify any provision of this section or to make any guarantee, warranty, or representation, express or implied, orally or in writing, which is contrary to the foregoing.

Any description of the equipment, whether in writing or made orally by PSI or PSI’s agents, specifications, samples, models, bulletins, drawings, diagrams, engineering sheets or similar material used in connection with Buyer’s order are for the sole purpose of identifying the equipment and shall not be construed as an express warranty. Any suggestions by PSI or PSI’s agents regarding use, application or suitability of the equipment shall not be construed as an express warranty unless confirmed to be such in writing by PSI’s authorized officer.

**Consequential Damage Disclaimer**
PSI’s liability with respect to equipment proved to its satisfaction to be defective within the warranty period shall be limited to repair, replacement or refund as provided hereof, and in no event shall PSI’s liability exceed the purchase price of the equipment involved. Kelbro shall not be subject to any other obligations or liabilities, whether arising out of breach of contract, warranty, tort (including negligence) or other theories of law, with respect to equipment sold or services rendered by PSI, or any undertakings, act or omissions relating thereto. Without limiting the generality of the foregoing, PSI specifically disclaims any liability for property or personal injury damages, penalties, special or punitive damages, damages for lost profits or revenues, loss of use of equipment or any associated equipment, cost of capital, cost of substitute products, facilities or services, downtime, shutdown, or slowdown...
costs, or for any other types of economic loss, and for claims of Buyer's customer for any such damages.

PSI shall not be liable for and disclaims all consequential, incidental and contingent damages whatsoever. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under section 2-719 of the uniform commercial code, PSI shall have no liability to Buyer for consequential damages, such as lost profits, lost revenue, damage to other equipment or liability or injury to a third party.

**Indemnification by Buyer**
Buyer shall indemnify, hold harmless, and defend PSI and PSI’s employees and agents from and against any and all damages, liability, claims, losses and expenses (including reasonable attorneys’ fees, court costs, and out-of-pocket expenses) arising out of or resulting in any way from claims by customers of Buyer or third parties against PSI alleging a breach of contract or warranty by PSI to the extent that such damages, liability claims, losses and expenses which may be payable by PSI to Buyer pursuant to the and as limited by PSI’s warranty and damage obligations as contained hereof so as to effectively limit Kelbro’s obligations to customers of Buyer or third parties to those set forth.

**Return of Equipment**
No equipment or part shall be returned to Kelbro without written authorization and shipping instructions first having been obtained from PSI under the company's Return Policy.

**Return Policy:**
- Client/Customer requests an RMA from Sales Department
- Sales shall issue an RMA with an assigned number along with the Product Warranty information and a quote for replacement cost.
- Client/Customer issues a Purchase Order to PSI (pending evaluation), with the RMA properly filled in.
- Product is returned back to PSI at Client/Customers expense with all RMA documents for reference. If the product is warrantied, then the freight cost will be credited back.
- An evaluation will be conducted to determine warranty status.
- If product is not returned within 30 days of issued RMA, then an invoice will be issued regardless of warranty status.
- A copy of the evaluation is available upon request.
3.0 Lifting Procedure

Certified drawings provided with the equipment will take precedence over any information in this manual.

Lift the Pump at lift points only. Use properly rated slings capable of handling the weight of the equipment. Look for a buildup of dried solids or unsecured equipment on the unit that may fall during the lift or cause the lift load to exceed those listed in this manual. Use spreaders where applicable to avoid damage to the unit. Lift the unit where indicated and placed in position on the support structure.

Lift Point

Use properly rated sling to wrap around the motor. Be careful not to place stress on the junction box, damage may occur.

Forklifts can be used to lift.

Use forklift to lift.
Forks are to go into this channel.

Use forklift to lift.
Forks are to go into this channel.
4.0 Installation Procedure

The Motor/driver must operate the pump in a manner that the rotation of the pump Impeller when viewed from the suction (front) side of the pump is COUNTER-CLOCKWISE. The pump must not be operated in the reverse direction if damage to the pump is to be avoided.

The suction and discharge valves must not be completely closed when operating the pump.

The packing should be adjusted in a manner that a small amount of leakage remains for lubrication and cooling purposes.

For drilling mud operations, care must be taken to prevent seepage from the packing to dry out and coagulate in the areas of the front Seal and the slinger.

Do not operate the pump outside its designed performance envelope.

**FAILMRE TO PROPERLY INSTALL, OPERATE AND MAINTAIN PUMPS AND/OR COMPONENTS CAN CAUSE SEVERE INJURY OR UNIT FAILURE.**

Location

To eliminate the need for priming, the pump suction should be at a lower level than the level of the liquid in the supply tank/reservoir.

Foundation/Substructure Requirements

It is recommended to pour a concrete foundation on a solid base and it should be big enough to support the whole pump unit. The rigidity of the base plate will play an important role in damping out structural vibrations so the foundation must be thick enough to accomplish that. Refer to Hydraulic Institute’s Standard ANSI/HI 1.4-2000 for guidelines on this subject. Care must be taken to level the base plate in a horizontal position. Also, when the application dictates the use of fabricated bases, the foundation design must account for it properly, so that it can effectively dampen the resulting resonant vibrations.

Alignment

For any rotating machinery, the alignment of power transmitting and power consuming parts is critical for its safe and long lasting service. Even if the motor and the pump were aligned before shipping, it is very important to check the alignment after installation to ensure that the arrangement has not moved during transportation or handling. We cannot overemphasize proper alignment since it can mean the difference between a smooth and long lasting pump operation as opposed to high vibrations and even failure of Bearings, Coupling, Pump or the Motor. It should be noted that one must not try to align the Pump and the Motor until its flange and mounting Bolts have been tightened.

To perform the Coupling alignment with dial indicators, which are the instruments of choice for such procedures, the dial indicator is attached to one Coupling half with the indicator dial button resting on the outside diameter (OD) of the other Coupling half. This will give the offset misalignment between the two Shafts. In order to find out the angular misalignment, let the dial indicator button ride on the face of the other coupling half, instead of its OD. A TIR of 0.005” or less is usually considered acceptable by most manufacturers. If the TIR is more than that, it can be adjusted by loosening the pump or driver mounting Bolts, adding or removing shims accordingly and then tightening down the Bolts again. See Figures 1 and 2 as seen below.
For situations where a dial indicator is not available, one can use a straight edge to perform a reasonable alignment. This method works better when the Coupling has a rubber or a flexible drive element.

To check for offset misalignment, place the straight edge on the OD of the Couplings. If they are aligned there will not be any gaps under the straight edge. A Max gap of 1/64in. is allowed. This procedure should be repeated for at least one more location on the circumference of the Coupling 90 degrees from the first position.

To check for angular misalignment, the two Coupling mating faces should not have a variation in the gap, all around the faces. A maximum variation of 1/64 in. is permissible. See figures 3 and 4 below.

More information on coupling alignment can be found in the Hydraulic Institute’s Standard ANSI/HI 1.4-2000.
Piping

It is important that the piping should line up to the pump without it having to be drawn closer by tightening the companion flange Bolts. Also, the pump should not have to support the weight of the piping. For this to happen, it is better to have the piping anchored independently but as close to the pump as possible. It should also be pointed out that the piping should not be connected to the pump until the grout has hardened and after the Motor and pump mounting Bolts have been tightened.

Suction Piping

Suction piping can not only play a critical role in causing vibration and cavitation in centrifugal pumps, but can also be responsible for causing packing and Mechanical Seal failures as well as putting extreme loads on the Bearings. It is therefore very important that the size of the suction piping be at least the same or larger than the suction port of the pump.

To eliminate air pockets in the suction line, it is beneficial for the suction line to have a gradual slope down to the supply tank or source.

It is recommended that the flow through the pump should not be controlled by adjusting a valve in the suction line. However, this does not preclude the use of a suction line shut off valve to be used when the pump has to be inspected or removed for maintenance purposes.

In order to have a relatively turbulence free flow into the pump, it is good practice to have a straight length of pipe, at least twice its diameter in length e.g., a 6-inch suction pipe should have at least one foot of straight pipe just before the pump.

In situations which might require a flexible hose to be used in the suction line, it is imperative that such a flexible hose be of the non-collapsing type, since it is not uncommon to have suction pressures which are below atmospheric pressure. In such a scenario, there is a real possibility of starving the pump and thus causing it to overheat.

Discharge Piping

Like the suction piping, a shut off valve should be used in the discharge piping as well, to enable the removal of the pump for maintenance purposes. A throttle valve can be used in the discharge line to operate the pump at its design point, if the exact operating conditions are not known.

In case of a closed pressurized loop, it is necessary to have a check valve between the pump and the throttle valve, to prevent the product from flowing back through the pump.

In the absence of the check valve, such a circumstance can cause the Impeller to come loose and cause damage to the pump and also result in leakage beneath the Shaft Sleeve.

Electrical Installation

1. A qualified electrician should make all electric connections to the unit.

2. Make sure unit is grounded.

CAUTION: USER MUST PROVIDE A DISCONNECTION DEVICE BREAKER IN ACCORDANCE WITH LOCAL ELECTRICAL CODES.
3. Turn on power momentarily and check for correct rotation. If it is not correct, the qualified licensed electrician should shut off the power at the breaker and lock it out. Then disconnect and interchange any two of the three wires of the power cord where the connection is made.

**NOTE:** Typically the motor junction box will have instructions inside or there will be a wiring diagram on the motor tag.

### 5.0 Operation

**Before proceeding, check all fasteners to make sure that they are tight and that all parts are secure prior to continuing. Under no circumstances shall the pump be operated without an installed coupling and/or belt guard (If applicable).**

For maintenance repair, or cleaning, follow approved positive electrical “lock out and tag” procedures.

All wire connections must be secure, protected, and covered.

Before starting the pump, it is good practice to always go through the following simple checks:

1. Check for Impeller’s free rotation by turning the Shaft by hand.
2. Make sure that the suction line and the pump are full of fluid and that the suction valve is fully open.
3. Slightly open the discharge valve and then open it fully once the pump is running.

**Preliminary Lubrication**

Our standard pumps come pre lubricated with grease (oil lubrication is available as an option). The operators/customers do not have to worry about lubricating the pump for the first year of operation. At that time, the pump can be lubricated through the Outboard and Inboard Bearing Covers by removing the Plugs and replacing them with the appropriate lubrication fittings.

Usually, Labyrinth Seals are provided at both Bearing ends, and they serve to keep the temperature from rising, by also acting as vents. But in cases where the Labyrinth Seals are not provided, it is recommended to keep the air vent clean.

**Mechanical Seal Pumps**

It is vital that these pumps are never started dry otherwise it will cause irreparable damage to the Seal faces. The factory installs and adjusts the Mechanical Seals before shipping the pumps. The Seal models currently being provided with the MAKDADDY® 2.5 in. do not require external flush.

Pumps with Mechanical Seals come with 3 rings of backup packing which should be kept completely loose until a Seal failure occurs. Only then should they be tightened down to prevent leakage.

**Packed Pumps**

When starting packed pumps, the packing should be loose and the Packing Gland Nuts should only be hand tight. Once the pump starts running, slowly tighten the packing down. Make sure that there is some leakage through the packing, otherwise it will overheat and fail. If outside flushing is required on either pump models, the flush lines should be connected and checked for flow through them, before starting the pump.
**Pump Rotation**

Before running the pump it is important to find out the direction of rotation, since starting the MAKDADDY© 2.5 in. in the reverse direction can unscrew its Impeller and thereby cause damage to the pump and the Seal. The direction of rotation can be checked in two ways. The Motor can be uncoupled from the pump and then started to check its direction of rotation. Or a person can start and immediately shut off the coupled Motor and pump assembly and have someone else watch as the shafting just turns over.

**Pump Priming**

To prevent damage to the Mechanical Seals or packing, there must be liquid in the suction line and the Casing, before the pump is started. Fill the suction line with the liquid and vent out any air that might be present in the line. The discharge valve should be barely open when the pump is started and only after the flow and pressure have stabilized that it should be adjusted to the required flow conditions. If the pressure fails to build, close the discharge valve and then reopen it to build discharge pressure. If flow difficulties continue, it may be an indication of improper installation or pump selection. Operators must not run the pump with the suction valve closed under any circumstances, as it will immediately overheat the pump and cause major damage to various components.

Also, running the pump with the discharge valve closed should be allowed only for short durations as the energy being imparted to the pumped product by the Impeller, will raise the temperature. If for some reason there is a need to keep the discharge valve closed for an extended length of time, then it is recommended to run a small (0.25" or 0.50") line, starting between the pump and the discharge valve and going back to the fluid supply tank.

**Start Up**

1. After installing and thoroughly inspecting the unit to ensure proper mounting and that all guards are installed, make sure that no foreign objects are in or near the unit.

**While running**

1. Make sure that there are no excessive or unusual vibration or noises originating in the unit.

**6.0 Routine Maintenance**

*Use proper lock-out/tag-out precautions when performing maintenance and/or when necessary.*

**Lubrication**

Your MAKDADDY© comes lubricated with grease when it is shipped from the factory and it does not need to be lubricated more than once per year.

The recommended grease is NLGI #2 LITHIUM COMPLEX.

When using different types of grease, care should be taken to use only those types of grease which are well suited to operate with each other.
The Outboard and Inboard Bearing Covers are provided with a grease fitting. It is recommended to add five shots of grease through the grease port at least once every six months, after the first year of service.

After Operation

Some of the important factors to watch for, while operating pump are;

1. The packing should not be over tightened as it will become hard and brittle and will fail to perform its function. But it is also important, especially when a water flush system is being employed to lubricate the Packing Rings, that rings be not too loose. That can result in flush water seeping into the drilling mud and changing its density. This situation can also arise due to a gap between the Shaft and the packing, which results due to the whirling of the Shaft about its own axis during pump operation and thus causing deformation of the packing. This predicament can be solved by either manually shutting off the water whenever the pump is not running or installing a solenoid valve for this purpose.

2. Another factor that should be controlled to limit the amount of water from getting into the drilling mud is the pressure of water for the flush system. Pressure as small as 5 psi is usually enough to provide the required lubrication for the Packing Rings. A pressure regulator should be preferably incorporated into the water flush system for this purpose.

3. Bearing failure is the biggest contributor to pump maintenance costs. So it is imperative that care be taken not to run the pump if the Bearing condition is suspect. A quick check that can be easily performed is to estimate the temperature of the pump housing by placing a hand on it. Usually if a person can comfortably keep his/her hand on the pump housing for a little while then the temperature is not more than 150°F. If the temperature seems more than that then the chances are either that the Bearings have started to fail or that there is a lack of lubrication for them. Replacing Bearings at this stage is more cost effective than waiting longer and then having to replace a number of other parts as well.
4. One of the most common reasons for bearing failure is misalignment between the pump and the Motor. Hence it is very important to check alignment not only before starting the pump for the first time but to also do it periodically.

5. Care should be taken not to increase the suction line velocity beyond 10ft/sec because that can result in turbulence as well as cavitation. These conditions will adversely affect the efficiency and the life of the pump, respectively.

6. Perhaps the most important factor for predictable pump performance is the Available Net Positive Suction Head (NPSHA). Simply put, it means that the height of the fluid in the supply tank above the suction level of the pump should be enough to prevent the fluid from entering the pump at a pressure which is below its vapor pressure at that temperature. If such flow conditions cannot be avoided, cavitation occurs which is the boiling of that fluid at the operating temperature and then the bubbles being created during that boiling process implode and damage the various pump and system components. Thus to prolong the life of the pump always ensure that the pump has the recommended NPSHA.

**Operational Safety**

1. Do not operate the pump with the outlet and/or inlet valve completely closed.

2. Any maintenance work on the pump must be done only when the pump is not running.

3. Both Inboard and Outboard Bearings should be replaced with new ones after 80% of their expected life span, which is 5,000 hrs.

4. If the Mechanical Seal starts to leak while the pump is operating, tighten the backup Packing Rings through the Gland Bolts, to reduce the leakage. This should give the operator some time to schedule a shut down for the pump and replace the Mechanical Seal.

5. The lifting eye supplied on the pump is rated for 990 lb. (or 450 kg). When assembled on a skid, do not use the pump lifting eye by itself to lift the whole assembly. Distribute the weight through the Skid, Pump and Motor lifting eyes.

6. Reverse rotation of the pump through improper electrical wiring connection can cause the Impeller to spin off the Shaft and possibly damage any or all of the following parts:
   a. Pump Shaft
   b. Impeller
   c. Casing
   d. Stuffing Box Cover
   e. Wear Pad

**7.0 Shut down and Storage**

**7.1 Emergency Shutdown**
An emergency shutdown may be necessary to clear obstructions or to replace damaged or worn components.

1. LOCKOUT/TAGOUT ALL POWER.
2. Remove all obstructions and product from the pump.
3. Inspect all components for damage or wear. Check the pumps components in accordance with the Maintenance Section of this document.
4. Replace all damaged or worn components.
5. Turn drive unit by hand to check for alignment and obstructions.
6. Restart the pump in accordance with the Operation Section of this document.
7.2 Extended Shutdown
An extended shutdown may be necessary if the degasser is not in operation for a long period of time.

1. LOCKOUT/TAGOUT ALL POWER.
2. Remove all obstructions and product from the pump.
3. Inspect all components for damage or wear. Check the pump components in accordance with the Maintenance Section of this document.
4. Replace all damaged or worn components.
5. Coat all exposed metal surfaces with rust preventative.
6. Rotate shaft by hand every week.
7. Place moisture soaking packs in motor junction box and in starter to prevent damage to wiring.

NOTE: When operation is to resume, restart the pump in accordance with the Operation Section of this manual.

7.3 Storage
Follow these instructions if the pump is to be shutdown longer than 6 months.

1. In case of indoor storage, it is desirable to avoid temperature extremes, excessive moisture and vibrations.

2. It should be standard procedure to check the resistivity of motor windings at the time of placing them in storage and again when it is time to take the Motor out and use it. A difference of more than 50% necessitates the drying of these windings before the pumps operation.

3. Whenever pulling the pump and the Motor out of storage, it is recommended to remove all the old grease from the Bearings and replenish them with fresh new grease.

4. It is also recommended to manually turn the Shafts of the Motor and the pump at least once every two months.

5. If the pumps are to be stored outdoors for an extended period of time, it is good practice to properly seal off the suction and discharge openings, to prevent rust from attacking the pump Casing and Impeller.

NOTE: When operation is to resume, restart the pump in accordance with the Operation Section of this manual.
8.0 Technical Manual Contents

8.1 General Description

The strict attention to design details, computerized modeling, quality materials and use of state of the art manufacturing methods give these pumps and their replacement parts superior durability and performance. The complete interchangeability of parts is maintained for other centrifugal pumps being used in the surface handling of drilling fluids by oilfield mud systems.

General Applications

• Fresh water    • Sea water    • Drilling mud

Standard Trim Includes

<table>
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<tr>
<th>Component</th>
<th>Material</th>
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<tbody>
<tr>
<td>Frame</td>
<td>Cast Iron</td>
</tr>
<tr>
<td>Shaft</td>
<td>4140 Low alloy steel</td>
</tr>
<tr>
<td>Shaft Sleeve</td>
<td>416 Stainless steel</td>
</tr>
<tr>
<td>Casing</td>
<td>Hard iron/Cast iron</td>
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<tr>
<td>Wear Pad</td>
<td>Hard iron</td>
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<tr>
<td>Labyrinth Seals/Isolators</td>
<td>Bronze</td>
</tr>
<tr>
<td>Mechanical Seal</td>
<td>Heavy duty tungsten carbide with Viton® bellows</td>
</tr>
</tbody>
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Features

• Replaceable wear pads
• Full and semi-open impellers
• Stainless steel casing nuts
• Inboard bearings consist of high quality double row angular contact ball bearings or cylindrical roller bearing
• Outboard bearings consist of 2 high quality single row angular contact ball bearings
• Mechanical seals combine tungsten carbide and Viton® bellows to extend seal life
• Each skid mounted pump package is designed to ensure job site ease of maintenance and serviceability

Sizes (Impeller sizes vary by customer requirements)

- 3 x 2 x 13 in
- 4 x 3 x 13 in
- 5 x 4 x 14 in
- 6 x 5 x 11 in
- 6 x 5 x 14 in
- 8 x 6 x 11 in
- 8 x 6 x 14 in
8.2 General Arrangement

Motor and Pump configurations vary based on customer specifications.
9.0 Parts List

Casing and parts

Frame Stuffing Box Cover, Impeller and Parts
Impeller, casing, and skid size are determined by customer specs and requirements.
<table>
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<tr>
<th>Number</th>
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<th>Part Number</th>
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Company Propriety and Confidential
10.0 Inspection and Tests

SEE ATTACHED (if applicable)

11.0 Certification(s)

SEE ATTACHED (if applicable)

12.0 Pump Curves

3 x 2 x 13 in. - Variable Speed

![Graph showing Pump Curves]

IMPELLER DIAMETER 13 in.

Maximum Sphere - 1/2 in.
3 x 2 x 13 in. - 1150 RPM

Calculating horsepower using efficiency:

$$BHP = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}$$

$$\text{kW} = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}$$

Maximum Sphere - 1/2 in.
3 x 2 x 13 in. - 1750 RPM

Calculating horsepower using efficiency:

\[
BHP = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
kW = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 1/2 in.
3 x 2 x 13 in. - 3500 RPM

Calculating horsepower using efficiency:

\[
BHP = \frac{GPM \times FT \times SG}{3960 \times Efficiency}
\]

\[
kW = \frac{M^3/hr \times M \times SG}{367 \times Efficiency}
\]

Maximum Sphere - 1/2 in.
4 x 3 x 13 in. - Variable Speed

IMPELLER DIAMETER 13 in.

Maximum Sphere - 3/4 in.
4 x 3 x 13 in. - 1150 RPM

Calculating horsepower using efficiency:

\[ BHP = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}} \]

\[ kW = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}} \]

Maximum Sphere - 3/4 in.
4 x 3 x 13 in. - 1750 RPM

Calculating horsepower using efficiency:

\[
BHP = \frac{GPM \times FT \times SG}{3960 \times \text{Efficiency}}
\]

\[
kW = \frac{M^3/hr \times M \times SG}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 3/4 in.
4 x 3 x 13 in. - 3500 RPM

Calculating horsepower using efficiency:

\[
BHP = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
kW = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 3/4 in.
5 x 4 x 14 in. - Variable Speed

IMPELLER DIAMETER 13 in.

Maximum Sphere - 13/32 in.
5 x 4 x 14 in. - 1150 RPM

Calculating horsepower using efficiency:

\[ BHP = \frac{GPM \times FT \times SG}{3960 \times \text{Efficiency}} \]

\[ kW = \frac{M^3/hr \times M \times SG}{367 \times \text{Efficiency}} \]

Maximum Sphere - 13/32 in.
5 x 4 x 14 in. - 1750 RPM

Calculating horsepower using efficiency:

\[
BHP = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
kW = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 13/32 in.
6 x 5 x 11 in. - Variable Speed

IMPELLER DIAMETER 11 in.

Maximum Sphere - 15/16 in.
6 x 5 x 11 in. - 1150 RPM

Cubic Meters per Hour (M³/hr)

Total Differential Head (Feet)

US Gallons per Minute (GPM)

Calculating horsepower using efficiency:

\[
BHP = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
kW = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 15/16 in.
6 x 5 x 11 in. - 1750 RPM

Calculating horsepower using efficiency:

\[
BHP = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
kW = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 15/16 in.
6 x 5 x 14 in. - Variable Speed

IMPELLER DIAMETER 14 in.

Maximum Sphere - 15/16in.
6 x 5 x 14 in. - 1150 RPM

Calculating horsepower using efficiency:

\[
\text{BHP} = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
\text{kw} = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 15/16 in.
6 x 5 x 14 in. - 1750 RPM

Calculating horsepower using efficiency:

\[
BHP = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
kW = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 15/16 in.
8 x 6 x 11 in. - Variable Speed

![Graph showing cubic meters per hour versus US gallons per minute for a 11 in. impeller diameter.]  

**IMPELLER DIAMETER**: 11 in.  

**Maximum Sphere**: 15/16 in.
8 x 6 x 11 in. - 1150 RPM

US Gallons per Minute (GPM)

Calculating horsepower using efficiency:

\[
BHP = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
kW = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 15/16 in.
8 x 6 x 11 in. - 1750 RPM

Calculating horsepower using efficiency:

\[
\text{BHP} = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
\text{kW} = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 15/16 in.
8 x 6 x 14 in. - Variable Speed

IMPELLER DIAMETER 14 in.

Maximum Sphere - 1-3/8 in.
8 x 6 x 14 in. - 1150 RPM

Calculating horsepower using efficiency:

\[
BHP = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
kW = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 1-3/8 in.
8 x 6 x 14 in. - 1750 RPM

Calculating horsepower using efficiency:

\[
\text{BHP} = \frac{\text{GPM} \times \text{FT} \times \text{SG}}{3960 \times \text{Efficiency}}
\]

\[
\text{kW} = \frac{\text{M}^3/\text{hr} \times \text{M} \times \text{SG}}{367 \times \text{Efficiency}}
\]

Maximum Sphere - 1-3/8 in.
13.0 Contact Information

Replacement parts for PSI SUPPLIED equipment can be ordered from Process Solutions International or any of their agents, worldwide. Please include the model number if possible.

To order parts or to receive technical support via telephone, contact Process Solutions International using the information listed below.

Process Solutions International
A Division of Kelbro, Inc.
7519 Prairie Oak Drive
Houston, TX 77086
(281) 893-4774; FAX (281) 893-1027